

# **Student Value Model**

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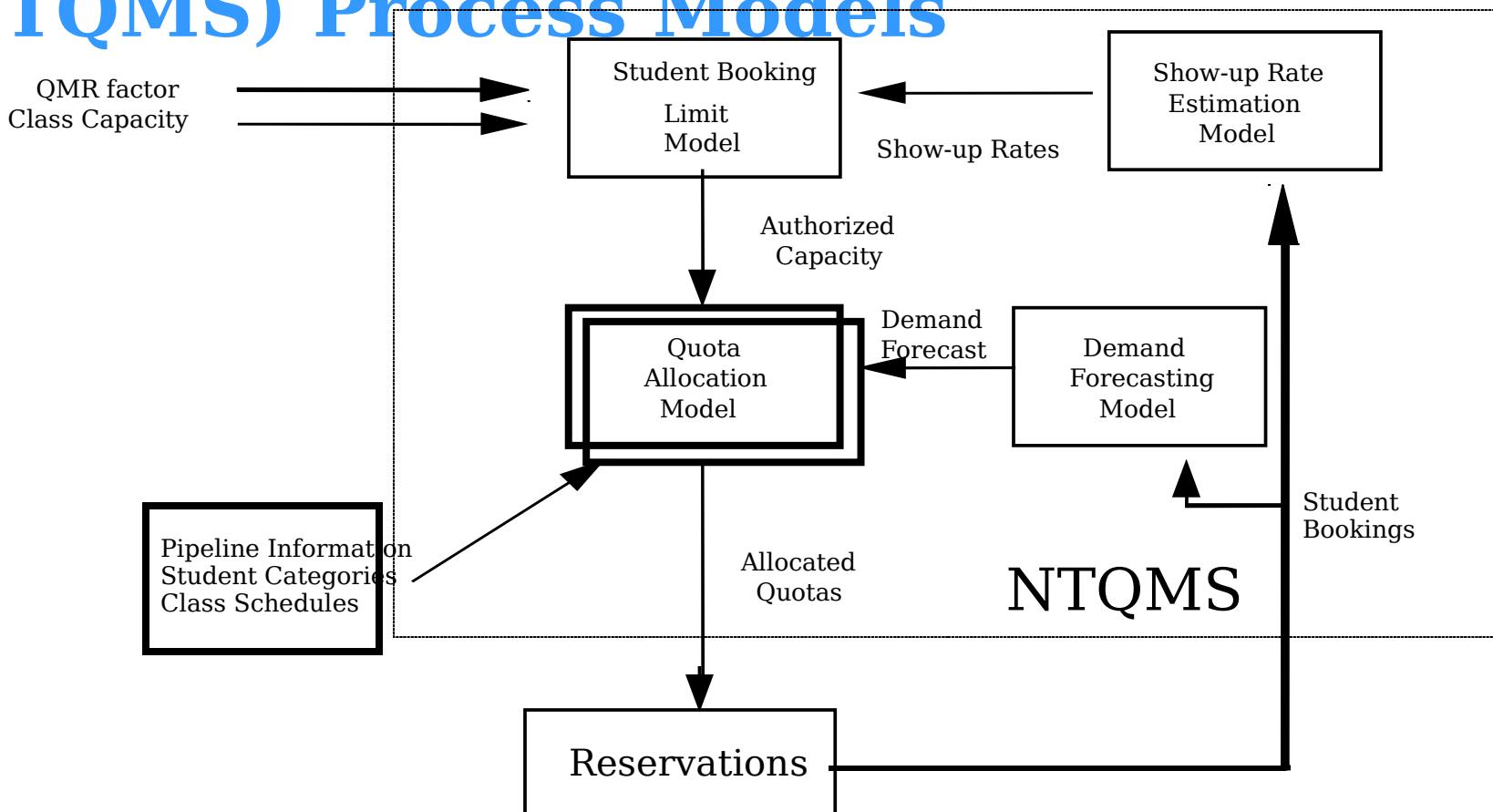
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# Problem Statement

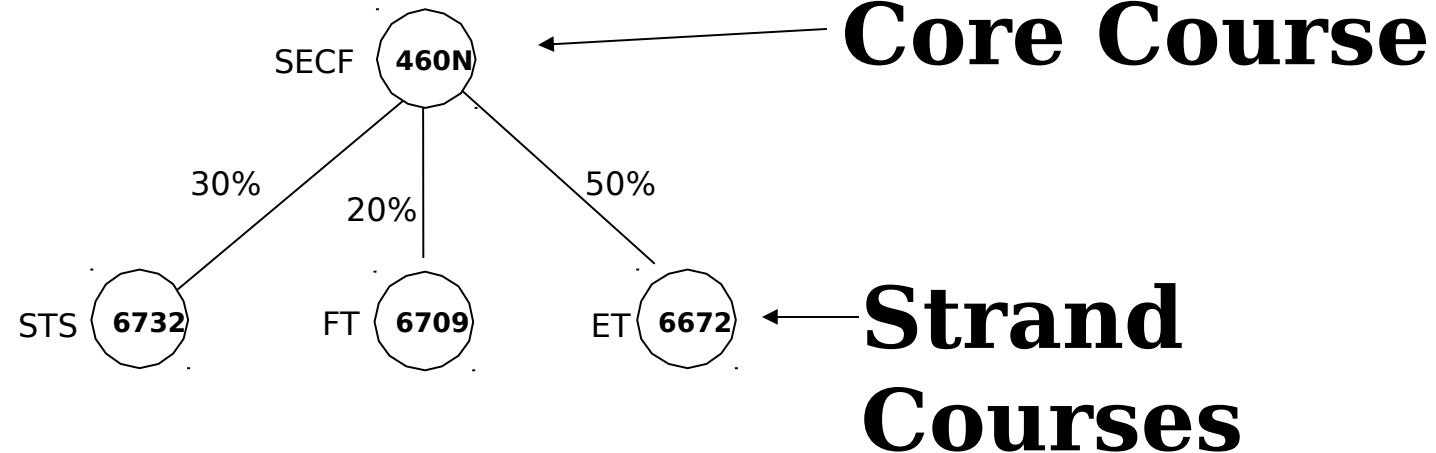
- **Develop a Student Value Model that determines the relative value of training different Student Groups (SGs)**
  - **To help the Navy train the right student on the right skill at the right time**
    - ★ **Quota Allocation**
- **Secondary Objectives**
  - **To support Navy Recruit Classification**
    - **Bonus Assignment**
  - **To support Navy Training Management**
    - **Training Resource Allocation**

# Navy Training Quota Management System (NTQMS) Process Models

NPRST



# Operational Problems: Pipelines

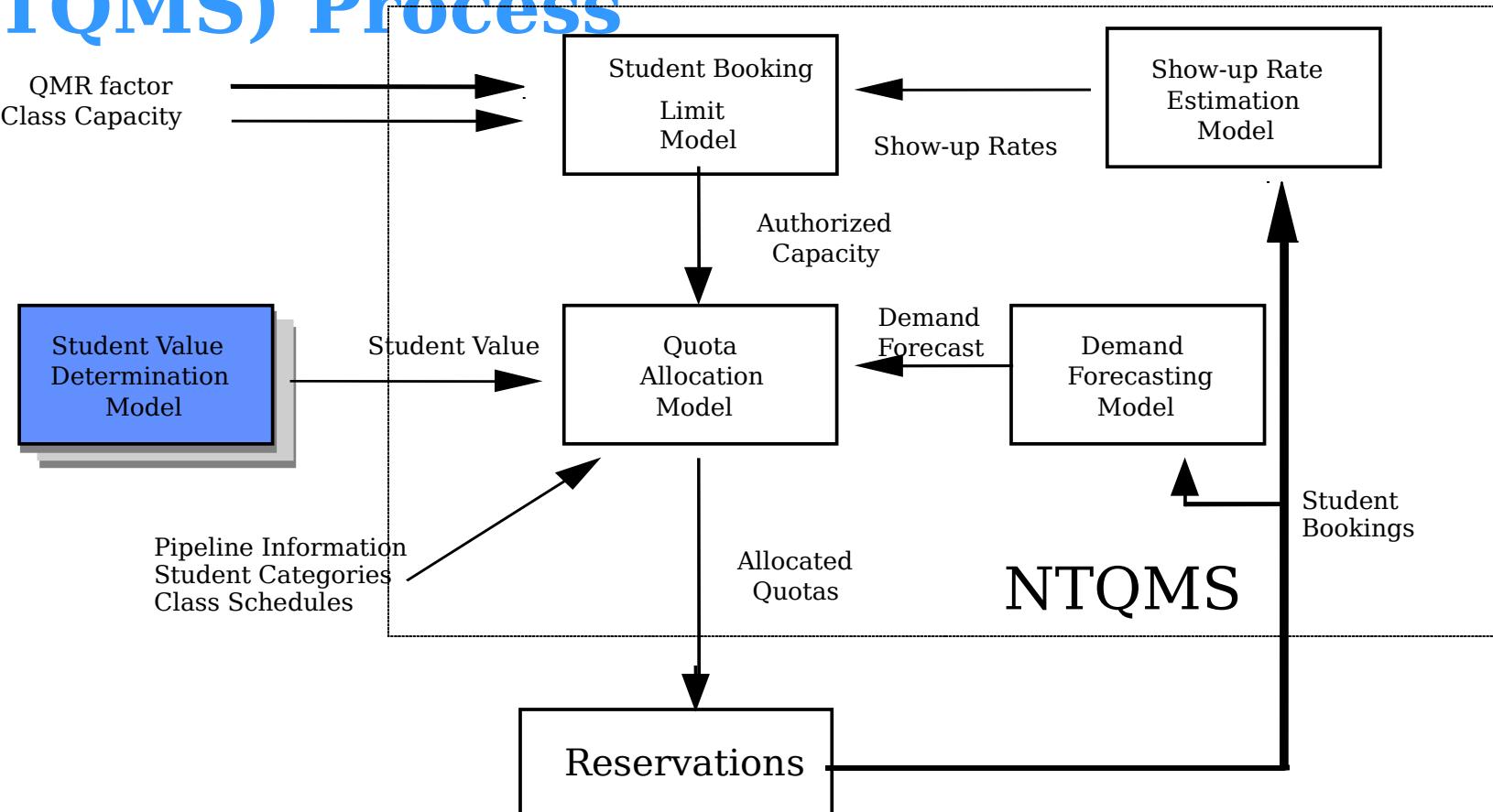


- Core courses are an allocation choke point in student training. Seats are currently allocated “first come first served” to predetermined static levels. In determination of training seat allocation, all students are viewed equal regardless of the training community’s Manning.

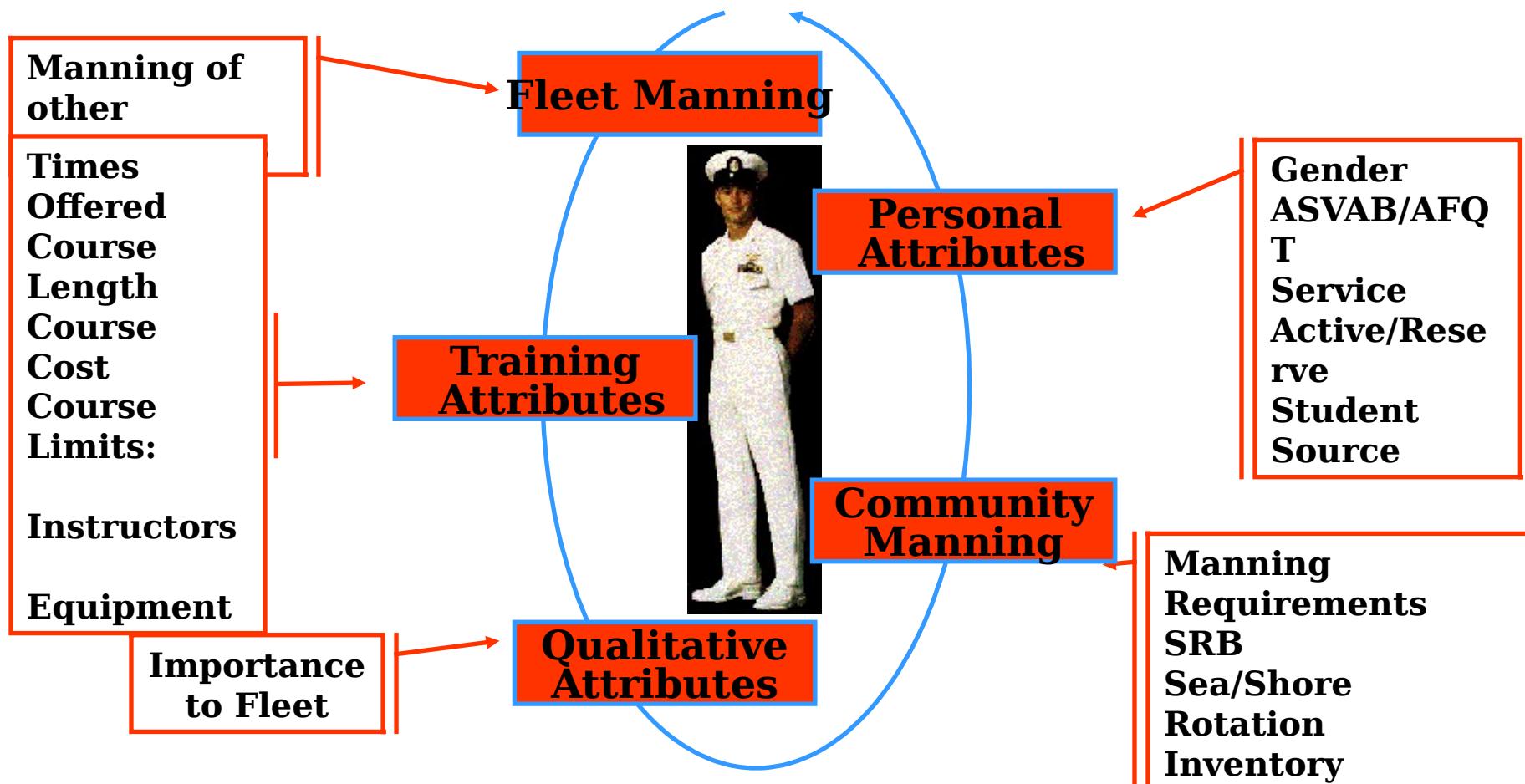
- Determining value of a Sailor/student for initial allocation of training seats.
- Reallocation of training seats based on student value.

# Navy Training Quota Management System (NTQMS) Process

NPRST



# Student Value - A function of

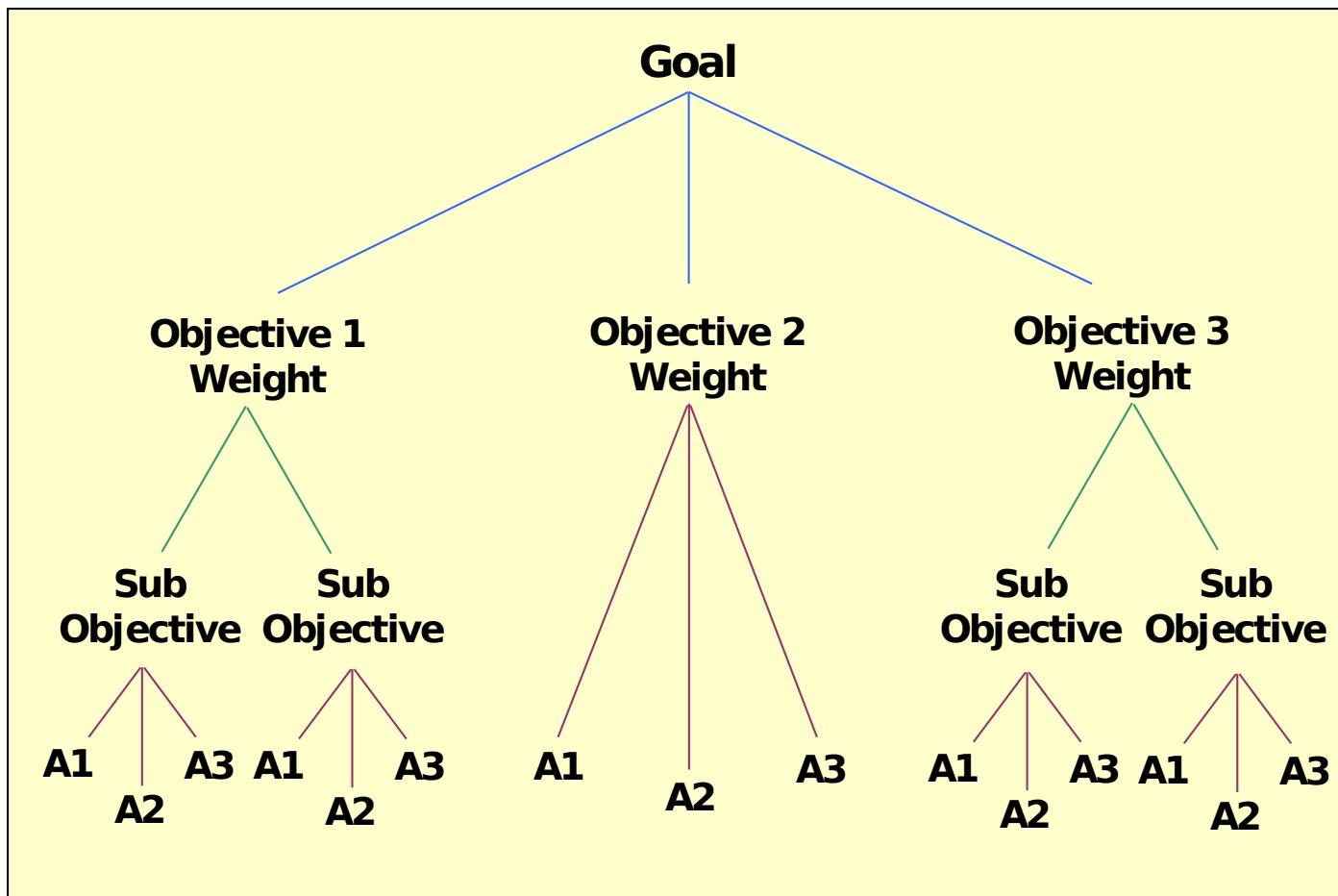




# SVM Methods

- **Analytic Hierarchy Process (AHP)**
- **Data Envelopment Analysis (DEA)**
- **Hybrid DEA and AHP**

# The Analytic Hierarchy Process (AHP)



# AHP Problem Statement

## □ Given

- **m objectives: OBJ 1 to OBJ m**
- **n alternatives: ALT 1 to ALT n**

## □ Determine

- **$V(j)$  = value of alternative j with respect to all objectives**

## □ For SVM:

- **Alternative is equivalent to a SG**
- **Objective is equivalent to a component of the SG value**

# AHP Pros and Cons

## Advantages

- **Structure**
- **Pair wise comparisons**
- **Weighted sum approach**

## Drawbacks

- **Subjectivity**
- **9 point scale**
- **No. of pair wise comparisons maybe too large**

# DEA Problem Statement

## Given

- $n$  similar units (business units, student groups)
- $m_1$  inputs, i.e. resources utilized
- $m_2$  outputs, i.e. objectives achieved

## Determine

- The relative performance of these units accounting for the resources used and the objectives achieved

# DEA Process Equation

## □ Define

- **Output Measure = Sum {  $v(j) * \text{output}(j)$  }**
- **Input Measure = Sum {  $u(k) * \text{input}(k)$  }**
- **Efficiency = Output Measure / Input Measure**

## □ Solve a **LINEAR PROGRAM** for every unit:

- Determine weights  $u$  and  $v$  that will

★ **Maximize Unit Efficiency**

### □ **s.t.**

★ Efficiency  $\leq 100\%$  for all units

□ Weights  $> 0$

# DEA Pros and Cons

## Advantages

- **Input/output paradigm**
- **LP based**
- **Objectivity**
- **Repeatable results**

## Drawbacks

- **Low discrimination power**
- **Maverick Groups**
- **Non-unique optimum weight vectors**

# AHP & DEA Evaluation

Features	AHP	DEA
<b>Desirable</b>	<ul style="list-style-type: none"><li>❖ Weighted sum approach</li><li>❖ Provides ranking of all alternatives</li></ul>	<ul style="list-style-type: none"><li>❖ LP based</li><li>❖ Objective</li><li>❖ Repeatable</li></ul>
<b>Undesirable</b>	<ul style="list-style-type: none"><li>❖ 9 Point scale</li><li>❖ Subjective</li></ul>	<ul style="list-style-type: none"><li>❖ No ranking of efficient units</li></ul>

# AHP and DEA Hybrid

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DEA	SVM	AHP
<b>Business Units</b>	<b>Student Groups</b>	<b>Alternatives</b>
<b>Inputs</b>	<b>Navy Recruiting and Training Investments</b>	<b>Objectives</b>
<b>Outputs</b>	<b>Navy Return on Investment</b>	<b>Objectives</b>
<b><i>U and V</i></b>	..... 	<b><i>W</i></b>

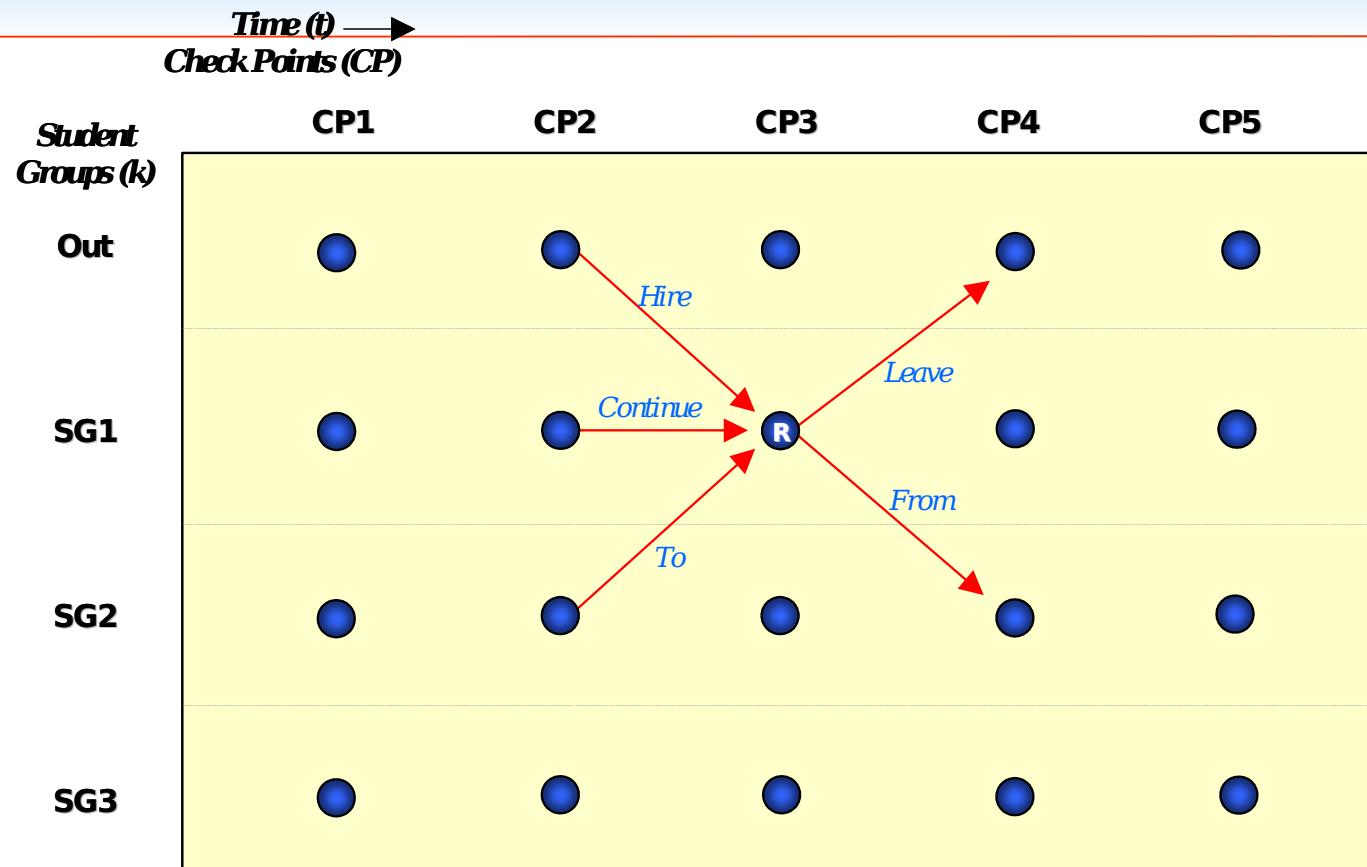
# Static vs. Dynamic Value



- **Think of SG Value to have two components**
- **Static Value**
  - **Accounts for Navy investments in recruiting and training and expected return on investment**
- **Dynamic Value**
  - **Accounts for shortages over time using latest information**

# Group Size Dynamics

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# Shortage

- **RSH(k,t)**
  - = Relative Shortage in SG(k) at the beginning of time period t
  - = [Planned accessions - Actual accessions] / [ Actual acc.]
- **Dynamically adjust the SGV as follows**

$$\text{SGV}(k,t) = \text{SGV}(k) * [1 + a . \text{RSH}(k,t) ]$$

# *Q&A Session*